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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] About a urination warning device, in detail, the function of a urinary system falls and this invention relates to the uresiesthesia warning device which warns [the patients who worry about incontinentia etc.] of uresiesthesia before being incontinent.

[0002]

[Description of the Prior Art] In the living body, superfluous moisture is stored within a bladder via a ureter from the kidney, and if it reaches a urination level, it will be discharged by uresiesthesia together with unnecessary metabolite to the outside of the body. However, if abnormalities are produced by damage to the autonomic nerve which governs a bladder, an optional nerve, and a mechanism of micturition, etc. or a urination function falls, the uresiesthesia which is natural physiological response will be lost and it will become easy to produce urinary incontinence.

[0003] An ultrasonic wave as one of the used uresiesthesia sensors in recent years by JP, 7-171149, A. The ultrasonic probe with which the ultrasonic wave was provided with the vibrator irradiated with and received for urine volume detection of an outline and a patient, The driving source of the ultrasonic probe concerned, and the signal processing machine style which judges whether the reservoir urine volume of a bladder is a urination level with the ultrasonic reception sensitivity of a wall of urinary bladder, The urination warning device which the urination warning device which mainly comprises the alarm emitted to a patient or a care worker was proposed when reservoir urine volume was judged to have reached the urination level, and used this ultrasonic wave is reported by the 37th time of Japan Ergonomics Society convention etc.

[0004] By the way, the above-mentioned urination warning device detects the urine level in a bladder by four vibrators which changed the angle of inclination into the stature direction of the human body, and have been arranged in it. A vibration pulse is supplied to the above-mentioned vibrator one by one in time sharing, and specifically, it is constituted so that the vibrator of the ultrasonic irradiation angle from which the level of an ultrasonic reflection echo [near urination RE ** RU] serves as the maximum may be used as a vibrator for urination measurement.

[0005] And a judgment of being a urination level is made as follows. Namely, when distance between the front wall of a bladder and a posterior wall of stomach was set

to Di and posterior-wall-of-stomach echo intensity is set to Pi, When the regulation value defined by following formula (II) is made into the index value of judgment of being a urination level (in the case [However, i] of four-channel type 4 of A-D) and the value more than this PD value is shown, warning which reached the urination level is performed to the subject (for example, the 356-357th page of a 32nd volume of ergonomics special number).

[0006]

[Equation 2]

$$D$$

$$PD = \sum_{i=A}^D P_i \times D_i \dots \dots \dots (II)$$

$$i = A$$

[0007]However, in the case of the above-mentioned warning device, the ultrasonic wave can have breadth in the stature direction of a human body, and it can transmit and receive, but there is a problem of receiving restrictions strong against the state of the posture of the subject practical. Namely, when a bladder inclines toward right and left in an abdomen by change of the posture of the subject, specifically, Also when an ultrasonic wave is not equivalent to a bladder broadly when the subject which is sleeping on its back on the bed twists the body crosswise [of a human body], and it hits, in order to change as compared with the case where the amount of ultrasonic signals received is sleeping on its back, Judgment of being a urination level which uses the above-mentioned PD value cannot be performed correctly. Therefore, the above-mentioned urination warning device cannot act effectively only in the state of the posture limited extremely.

[0008]

[Problem(s) to be Solved by the Invention]this invention is made in view of the above-mentioned actual condition, and comes out. The purpose is to provide the urination warning device which can judge that it is a urination level, without being influenced by the state of the posture of **.

[0009]

[Means for Solving the Problem]Namely, an ultrasonic probe with which a gist of this invention was provided with a vibrator by which an ultrasonic wave is irradiated with and received for a patient's urine volume detection, A driving source of the ultrasonic probe concerned, and a signal processing machine style which judges whether reservoir urine volume of a bladder is a urination level with ultrasonic reception sensitivity of a wall of urinary bladder, In a urination warning device which mainly comprises an alarm emitted to a patient or a care worker when reservoir urine volume is judged to have reached a urination level, An ultrasonic probe is constituted by two or more channels which comprise a column direction channel group (number of column groups ≥ 2) arranged in a stature direction of a human body, and a line writing direction channel group (number of line groups ≥ 1) arranged crosswise [of a human body], An ultrasonic probe drives for every sequence channel by a driving source, and by a signal processing machine style. It consists in a urination warning device, wherein the maximum for every sequence channel of ultrasonic reception sensitivity is compared, and an optimum-sensitivity sequence is become final and conclusive and a judgment of being a urination level is made by all the channels within the optimum-sensitivity sequence concerned.

[0010]

[Embodiment of the Invention] Hereafter, this invention is explained in detail based on an accompanying drawing. The explanatory view showing one example of the ultrasonic probe which uses drawing 1 with the urination warning device of this invention, and drawing 2 are the explanatory views showing one example of connection with each channel of an ultrasonic probe and driving source which are used with the urination warning device of this invention.

[0011] The ultrasonic probe provided with the vibrator by which the fundamental composition of the urination warning device of this invention is conventionally the same as a publicly known device, it glares, and an ultrasonic wave is received for a patient's urine volume detection. It mainly comprises a driving source of the ultrasonic probe concerned, a signal processing machine style which judges whether the reservoir urine volume of a bladder is a urination level with the ultrasonic reception sensitivity of a wall of urinary bladder, and an alarm emitted to a patient or a care worker when reservoir urine volume is judged to have reached the urination level.

[0012] One of the features of the urination warning device of this invention has an ultrasonic probe (1) in the point constituted by two or more channels (CH) which comprise the column direction channel group (number of column groups ≥ 2) arranged in the stature direction of a human body, and the line writing direction channel group (number of line groups ≥ 1) arranged crosswise [of a human body]. In the case of the ultrasonic probe (1) shown in drawing 1, a column direction CH group comprises three rows of A-C, a line writing direction CH group comprises four lines of 1-4, and a sum total CH number is 12.

[0013] As a desirable mode, one piezo electric crystal element is used for the ultrasonic probe (1) shown in drawing 1, for example, it is divided into two or more CH(s) by electrode formation or other means. As shown in drawing 1, 12CH formation of the Au-Cr electrode (12) of a predetermined size is carried out by sputtering process, and, specifically, the required poling process is performed for the piezo electric crystal element (11) of one sheet. In drawing 1, the lead connected to each pole (12) has omitted the graphic display.

[0014] According to the above two-dimensional multi CH array structures, the field which sends and receives a signal is expanded and judging accuracy is raised. It is desirable when a direction with many line writing direction CH groups arranged especially crosswise [of a human body] solves the aforementioned problem by change of posture. However, as for CH group, in order that a drive circuit may become complicated and many CH numbers may cause a cost hike, 3-5 are too preferred [a column direction and a line writing direction].

[0015] In this invention, it is preferred that the vibrators of at least some ultrasonic probes in two or more CH(s) are a polymer type piezo electric crystal element in which curved-surface formation is possible, 0-3 type compound piezo electric crystal element, 1-3 type compound piezo electric crystal element, and 2-2 type piezo electric crystal element. That is, in order to send and receive an ultrasonic signal from large range and field, without being influenced by the influence of posture change of the subject, it is preferred that it is CH which has the curvature of a convex to a human body, and the above piezo electric crystal elements in which curved-surface formation is possible are used suitably.

[0016] The above-mentioned polymer type piezo electric crystal element PVDF (polyvinylidene fluoride), PVDF-TrFe (polyvinylidene fluoride-trifluoro ethylenic copolymer), Comprise PVDCN-VAc (polyvinylidene cyanide vinyl acetate copolymer)

etc., and 0-3 type compound piezo electric crystal element, A piezo-electric granular material (for example, PZT granular material) is distributed in resin, and it is constituted, and in a resin matrix, 1-3 type compound piezo electric crystal element and 2-2 type compound piezo electric crystal element arrange a piezo-electric pillar, and are constituted. By excelling in piezoelectric property, since formation of a two-dimensional curved surface is easy, especially 1-3 type compound piezo electric crystal element is used suitably. As the above-mentioned resin, flexible resin of an epoxy system or a urethane system is used. The sizes of the ultrasonic probe shown in drawing 1 are 5 cm x 6 cm, for example, each curvature of the transverse direction and lengthwise direction for forming the curvature of a convex is determined suitably, and the angle which changes to each CH with these curvature is given.

[0017]An ultrasonic probe drives one of everything [the] but the feature of the urination warning device of this invention for every sequence CH by a driving source (2), and by a signal processing machine style (not shown). The maximum for every sequence CH of ultrasonic reception sensitivity is compared, an optimum-sensitivity sequence is become final and conclusive, and it is in the point constituted so that a judgment of being a urination level may be made by all the CH(s) within the optimum-sensitivity sequence concerned.

[0018]The drive of the ultrasonic probe for every [by a driving source (2)] sequence CH, for example, the case of the ultrasonic probe shown in drawing 1 -- A-1, A-2, A-3, A-4, B-1, and B-2 ... C-1 ... It is carried out by the switch with which the driving source (2) shown in drawing 2 corresponds one by one, and supplying a vibration pulse to the vibrator of each CH one by one in time sharing. [according to an order] Thereby, the vibrator of each CH vibrates, after it turns an ultrasonic wave to a wall of urinary bladder and it irradiates with it, receives the reflective echo and changes it into electrical energy.

[0019]Decision of the optimum-sensitivity sequence by a signal processing machine style (not shown) is attained by performing comparison assay of data, for example, after memorizing the maximum of the ultrasonic reception sensitivity for every sequence CH in a memory. Since the bladder exists in the body in the state nearest to the transceiver field from vibrator CHIANNERU of an optimum-sensitivity sequence, when decision of an optimum-sensitivity sequence makes a judgment with the reliability of being a urination level, it means reservation and selection of required and exact signal quantity. As long as it uses it, unifying, which value based on the front wall or posterior wall of stomach of a bladder may be sufficient as the maximum of the sensitivity to memorize.

[0020]the total within an optimum-sensitivity sequence -- judgment of being a urination level by CH can be preferably performed by a method as shown in the following (1) and (2).

[0021](1) From the reflective echo from the front wall and posterior wall of stomach of the bladder received from each CH ($i = 1, 2 \text{ and } 3, \dots n$) of an optimum-sensitivity sequence. How to use the index value computed from the function expression which measures P_i for the distance D_i between the front wall of a bladder, and a posterior wall of stomach, and the echo intensity of a posterior wall of stomach, and contains at least one of D_i and the $P_i(s)$ for judgment of being a urination level. Namely, a method of warning of it being in the state of a urination level, when a threshold with an index value is exceeded.

[0022](2) From the reflective echo from the front wall and posterior wall of stomach of the bladder received from each CH ($i = 1, 2 \text{ and } 3, \dots n$) of an optimum-sensitivity

sequence. How to use the index value computed from the function expression which measures the distance D_i between the front wall of a bladder, and a posterior wall of stomach, and the echo intensity P_i of a posterior wall of stomach, finds maximum distance for D_m value from the inside of said D_i measured further, and contains at least one of D_i and the $P_i(s)$, and the above-mentioned D_m value for judgment of being a urination level. Namely, a method of warning of it being in the state of a urination level, when a threshold with an index value and D_m value is exceeded.

[0023]When posture changes a lot and a bladder separates from a probe, since the signal from a posterior wall of urinary bladder is weak, said P value is observed small. On the other hand, D_m value is considered to be a barometer in the state where urine has been saved. Therefore, the above-mentioned method of (2) has change of posture, and also when a bladder is unevenly distributed in the inside of the body, it can raise the judging accuracy of being a urination level.

[0024]As function expression in above (1) and the method of (2), the following formula (1) can be used conveniently, for example. Formula (1) $Naka$ and $PDM(k)$ express an index value, and M_k expresses the value of optimum sensitivity.

[0025]

[Equation 3]_m

$$PDM(k) = \sum_{i=1} P_i \times D_i / M_k \cdots \cdots (1)$$

[0026]The above-mentioned formula (1) is an expression of relations which introduced the optimum sensitivity in the above-mentioned optimum-sensitivity sequence into the index value. A bladder serves as a bag with a certain volume in which urine accumulates. And the distance of a bladder and a probe changes as the position of a bladder changes according to posture. As a result, optimum sensitivity changes and each P_i value changes similarly. That is, when the distance between bladder-probes is near, M_k and P_i are observed greatly, and when conversely far, M_k and P_i are observed small. The above-mentioned formula (1) is an expression of relations which solved the problem of change of the signal strength by the position of a bladder, and raised the judging accuracy of being a urination level by introducing M_k value into an index value.

[0027]In this invention, a judging method of being a urination level is not limited to the above function expression which uses fixed D_m value, PD value, and a PDM value, for example, may specify a decision criterion of being a urination level as follows.

[0028]

[Table 1]

Dm値が3～5cmのとき	PD値があるしきい値A以上の場合
	PDM値があるしきい値B以上の場合
Dm値が6～10cmのとき	PD値があるしきい値C以上の場合
	PDM値があるしきい値D以上の場合

[0029]A time variation of D_m value, PD value, and a PDM value may be computed, and accuracy may be raised by using the value together. Specifically, it is good by combining some above decision results also as an algorithm which judges synthetically whether it is a urination level from PD value and a PDK value.

[0030]

[Example] Hereafter, although an example explains this invention still in detail, this invention is not limited to the following examples, unless the gist is exceeded.

[0031] As example 1 vibrator, the dielectric constant 900, the resonance frequency of 3 MHz of a thickness direction, and the electromechanical coupling coefficient of the thickness direction used the PZT system 1-3 compound piezo electric crystal element of 0.6, and the ultrasonic probe which comprises 12CH as shown in drawing 1 was created. Each CH has an electrode area of 8 mmx8 mm square.

The electrode carried out the weld slag of Au-Cr, and formed it.

And it was used, having made it change circularly in a transverse direction and a lengthwise direction so that it might have the curvature of a convex to a human body. Connection with each CH and driving source was made as shown in drawing 2. And the signal processing machine style was designed so that signal processing of the following procedures could carry out.

[0032] First, only four power supply circuits for a drive corresponding to the double-sided electrode of each vibrator arranged at 1-4 lines of A sequence are made to drive. the echo from a bladder -- waveform processing section **** of a signal processing machine style -- it is processed as follows.

[0033] That is, the distance D_i is calculated from the time and acoustic velocity between an anterior-wall-of-urinary-bladder reflection position and a posterior-wall-of-urinary-bladder reflection position (A, B, C, D). The reflectivity P_i of a posterior wall of stomach is measured, $D_i P_i$ is computed in each CH, a part for 4CH is added, and it memorizes as a PD value of A sequence. The maximum reflectivity value in the inside of the posterior-wall-of-stomach reflectivity of 4CH is memorized as posterior-wall-of-stomach maximum reflectivity of A sequence.

[0034] Then, only four power supply circuits for a drive corresponding to each vibrator arranged at 1-4 lines of B sequence are made to drive, and the measurement and processing same also about four vibrators of B sequence as the above are performed. Only four power supply circuits for a drive corresponding to each vibrator arranged at 1-4 lines of C sequence were made to drive, and the measurement and processing same also about four vibrators of C sequence as the above were performed.

[0035] The obtained maximum reflectivity is measured, after searching for the sequence from which maximum reflectivity is obtained, PD value of the sequence concerned and the PDM value further produced by breaking by maximum reflectivity of the sequence concerned are computed, and judgment and warning of being a urination level are given.

[0036] The ultrasonic probe of the urination warning device constituted as mentioned above was set to the suprapubic region of 20 normal uresiesthesia subject which fully senses uresiesthesia, and the following examinations were done.

[0037] It is made the posture which made the subject with the face upward make it a bed sideways, and leaned the body. And the judgment by the uresiesthesia and the PDM value which the subject realizes, the judgment by PD value, and the correlation in the case which considered D_m value further where a PDM value is specifically used for a judgment when it is more than D_m value $>3\text{cm}$ were taken, and the practicality of the warning device was evaluated.

[0038] As a comparative example, in the urination warning device constituted as mentioned above, it was used having stopped the function of A sequence of an ultrasonic probe, and C sequence, and the same examination as the above was

done. However, the judgment of uresiesthesia was taken as the judgment by PD value.

[0039]A test result is shown in the following tables. Also in the case where a uresiesthesia monitor is possible also for the place and all that used together and measured the PDM value, PD value, Dm value, and the PDM value in the case of this example, and posture changes from a state with the face upward a lot, Between the uresiesthesia level which the normal uresiesthesia subject realizes, and the judgment algorithm, strong correlation was accepted and it has been concluded that it was very useful as a urination warning device. On the other hand, although it was accepted when it was with the posture which does not twist the body on a bed in the case of a comparative example (angle -0), and reflectivity was observed and measurement of uresiesthesia was possible, when all the 20 bodies were leaned 10 degrees or more, observation of a signal is insufficient and a uresiesthesia monitor was not completed.

[0040]

[Table 2]

角 度	実 施 例			比 較 例
	Dm値およびPDM値	PRM値	PD値	P D値
1 5 度	1 9 人	1 4 人	8 人	0 人
2 0 度	1 6 人	1 1 人	3 人	0 人
3 0 度	1 2 人	8 人	0 人	0 人
4 0 度	1 0 人	4 人	0 人	0 人

[0041]

[Effect of the Invention]According to this invention explained above, the urination warning device which can judge that it is a urination level is provided without being influenced by the state of the posture of the subject, and the practical value of this invention is large.

[Translation done.]